

Design and Development of **EFFICIENT ENERGY SYSTEMS**

Edited by

Suman Lata Tripathi

Dushyant Kumar Singh

Sanjeevikumar Padmanaban

P. Raja



Table of Contents

[Cover](#)

[Title Page](#)

[Copyright](#)

[Preface](#)

[1 Design of Low Power Junction-Less Double-Gate MOSFET](#)

[1.1 Introduction](#)

[1.2 MOSFET Performance Parameters](#)

[1.3 Comparison of Existing MOSFET Architectures](#)

[1.4 Proposed Heavily Doped Junction-Less Double Gate MOSFET \(AJ-DGMOSFET\)](#)

[1.5 Heavily Doped JL-DG MOSFET for Biomedical Application](#)

[1.6 Conclusion](#)

[References](#)

[2 VLSI Implementation of Vedic Multiplier](#)

[2.1 Introduction](#)

[2.2 8x8 Vedic Multiplier](#)

[2.3 The Architecture of 8x8 Vedic Multiplier \(VM\)](#)

[2.4 Results and Discussion](#)

[2.5 Conclusion](#)

[References](#)

[3 Gas Leakage Detection from Drainage to Offer Safety for Sanitary Workers](#)

[3.1 Introduction](#)

[3.2 Related Works](#)

3.3 Methodology

3.4 Experimental Results

3.5 Conclusion

References

4 Machine Learning for Smart Healthcare Energy-Efficient System

4.1 Introduction

4.2 Related Works

4.3 Edge Computing

4.4 Smart Healthcare System

4.5 Conclusion and Future Directions

References

5 Review of Machine Learning Techniques Used for Intrusion and Malware Detection in WSNs and IoT Devices

5.1 Introduction

5.2 Types of Attacks

5.3 Some Countermeasures for the Attacks

5.4 Machine Learning Solutions

5.5 Machine Learning Algorithms

5.6 Authentication Process Based on Machine Learning

5.7 Internet of Things (IoT)

5.8 IoT-Based Attacks

5.9 Information and Identity Theft

5.10 Social Engineering

5.11 Denial of Service

5.12 Concerns

5.13 Conclusion

References

6 Smart Energy-Efficient Techniques for Large-Scale Process Industries

6.1 Pumps Operation

6.2 Vapour Absorption Refrigeration System

6.3 Heat Recovery Equipment

6.4 Lighting System

6.5 Air Conditioners

6.6 Fans and Other Smart Appliances

6.7 Motors

6.8 Energy-Efficient Transformers

References

7 Link Restoration and Relay Node Placement in Partitioned Wireless Sensor Network

7.1 Introduction

7.2 Related Work

7.3 Proposed K-Means Clustering Algorithm

7.4 System Model and Assumption

7.5 Results and Discussion

7.6 Conclusions

References

8 Frequency Modulated PV Powered MLI Fed Induction Motor Drive for Water Pumping Applications

8.1 Introduction

8.2 PV Panel as Energy Source

8.3 Multi-Level Inverter Topologies

8.4 Experimental Results and Discussion

8.5 Conclusion and Future Scope

References

9 Analysis and Design of Bidirectional Circuits for Energy Storage Application

9.1 Introduction

9.2 Modes of Operation Based on Main Converters

9.3 Proposed Methodology for Three-Phase System

9.4 Conclusion

References

10 Low-Power IOT-Enabled Energy Systems

10.1 Overview

10.2 Empowering Tools

10.3 Internet of Things within Power Region

10.4 Difficulties - Relating Internet of Things

10.5 Upcoming Developments

10.6 Conclusion

References

11 Efficient Renewable Energy Systems

Introduction

11.1 Renewable-Based Available Technologies

11.2 Adaptability Frameworks

11.3 Conclusion

References

12 Efficient Renewable Energy Systems

12.1 Introduction

12.2 Sources of Energy: Classification

12.3 Renewable Energy Systems

12.4 Solar Energy

12.5 Wind Energy

12.6 Geothermal Energy

12.7 Biomass

12.8 Ocean Power

12.9 Hydrogen

12.10 Hydro Power

12.11 Conclusion

References

13 Agriculture-IoT-Based Sprinkler System for Water and Fertilizer Conservation and Management

13.1 Introduction

13.2 Development of the Proposed System

13.3 System Description

13.4 Layers of the System Architecture

13.5 Calibration

13.6 Layout of the Sprinkler System

13.7 Testing

13.8 Results and Discussion

13.9 Conclusion

References

14 A Behaviour-Based Authentication to Internet of Things Using Machine Learning

14.1 Introduction

14.2 Basics of Internet of Things (IoT)

14.3 Authentication in IoT

14.4 User Authentication Based on Behavioral-Biometric

14.5 Threats and Challenges in the Current Security Solution for IoT

14.6 Proposed Methodology

14.7 Conclusion and Future Work

References

15 A Fuzzy Goal Programming Model for Quality Monitoring of Fruits during Shipment Overseas

15.1 Introduction

15.2 Proposed System

15.3 Work Process

15.4 Optimization Framework

15.5 Creation of Database and Website

15.6 Libraries Used and Code Snipped

15.7 Mode of Communication

15.8 Conclusion

Abbreviations

References

16 Internet of Things – Definition, Architecture, Applications, Requirements and Key Research Challenges

16.1 Introduction

16.2 Defining the Term Internet of Things (IoT)

16.3 IoT Architecture

16.4 Applications of Internet of Things (IoT)

16.5 Requirement for Internet of Things (IoT) Implementation

16.6 Key Research Challenges in Internet of Things (IoT)

References

17 FinFET Technology for Low-Power Applications

17.1 Introduction

17.2 Existing Multiple-Gate MOSFET Architectures

17.3 FinFET Design and Analysis

[17.4 Low-Power Applications](#)

[17.5 Conclusion](#)

[References](#)

[18 An Enhanced Power Quality Single-Source Large Step-Up Switched-Capacitor Based Multi-Level Inverter Configuration with Natural Voltage Balancing of Capacitors](#)

[18.1 Introduction](#)

[18.2 Suggested Topology](#)

[18.3 Cascaded Configuration of Suggested Topology](#)

[18.4 Modulation Technique](#)

[18.5 Power Loss Analysis](#)

[18.6 Design of Capacitors](#)

[18.7 Comparative Analysis](#)

[18.8 Simulation Results](#)

[18.9 Conclusions](#)

[References](#)

[Index](#)

[End User License Agreement](#)

List of Illustrations

Chapter 1

[Figure 1.1 2D view of AJ-DGMOSFET.](#)

[Figure 1.2 \$I_d\$ versus \$V_{gs}\$ plot of AJ-DGMOSFET.](#)

[Figure 1.3 \$I_d\$ Versus \$V_{gs}\$ plot with different oxide region material.](#)

[Figure 1.4 \$I_d\$ versus \$V_{gs}\$ Plot of different gate contact material.](#)

[Figure 1.5 JL-DG MOSFET with cavity region.](#)

[Figure 1.6 \$I_d\$ Versus \$V_{gs}\$ of AJ-DG MOSFET with varying dielectric constant \(Lcavi...](#)

Chapter 2

[Figure 2.1 Multiplication of two 8-bit number with Urdhwa-Tiryakbhyam Sutra \[28\]...](#)

[Figure 2.2 Block diagram of 8*8 multiplier.](#)

[Figure 2.3 Compressor 3:2.](#)

[Figure 2.4 Compressor 4:3.](#)

[Figure 2.5 Compressor 5:3.](#)

[Figure 2.6 Compressor 8 to 4.](#)

[Figure 2.7 Compressor 10 to 4.](#)

[Figure 2.8 Compressor 12 to 5.](#)

[Figure 2.9 Compressor 15 to 5.](#)

[Figure 2.10 Compressor 20 to 5.](#)

[Figure 2.11 Behavioral simulation of 8x8 VM.](#)

[Figure 2.12 Instance power usage of 8X8 vedic multiplier.](#)

[Figure 2.13 Instance power usage of 16X16 VM.](#)

[Figure 2.14 Net power usage of 8X8 VM.](#)

[Figure 2.15 Net power usage of 16X16 VM.](#)

Chapter 3

[Figure 3.1 Architecture of the proposed system.](#)

[Figure 3.2 Flow diagram of the automated system.](#)

[Figure 3.3 Gas sensor.](#)

[Figure 3.4 Raspberry pi.](#)

[Figure 3.5 Flow diagram of the leakage detection.](#)

[Figure 3.6 Experimental design.](#)

[Figure 3.7 Experimental design.](#)

Chapter 4

[Figure 4.1 Edge computing architecture.](#)

[Figure 4.2 Some of the applications of edge computing.](#)

[Figure 4.3 Advantages of edge computing.](#)

[Figure 4.4 Methodology of Smart Healthcare System.](#)

Chapter 5

[Figure 5.1 Security components.](#)

Chapter 6

[Figure 6.1 Pump cross section \(Source: Horizontal centrifugal pump, DMPE\) 1. Cas...](#)

[Figure 6.2 Pump impeller diameter characteristic curves \(Source: www.enggcyclope...](#)

[Figure 6.3 Motor with VFD.](#)

[Figure 6.4 Power and speed relationship.](#)

[Figure 6.5 Pump curve.](#)

[Figure 6.6 Retrofitted HT motor with LT motor and VFD.](#)

[Figure 6.7 Smart Industrial pump concept.](#)

[Figure 6.8 Basic components of VCR.](#)

[Figure 6.9 VAR system.](#)

[Figure 6.10 WHR scheme.](#)

[Figure 6.11 Street light control scheme by Wipro.](#)

[Figure 6.12 Street light control scheme by Tata Communications.](#)

[Figure 6.13 Sample star rating label.](#)

[Figure 6.14 Inverter operation.](#)

[Figure 6.15 IoT-enabled air conditioner.](#)

[Figure 6.16 Smart air conditioner.](#)

[Figure 6.17 Fan models.](#)

[Figure 6.18 USA Star rating label for fan.](#)

[Figure 6.19 Group control of fans.](#)

[Figure 6.20 Power flow stages in a motor.](#)

[Figure 6.21 Energy-efficiency ratings by EU.](#)

[Figure 6.22 Efficiency graph of transformer.](#)

[Figure 6.23 Super conducting transformers.](#)

Chapter 7

[Figure 7.1 Clustered wireless sensor network \[32\].](#)

[Figure 7.2 Flow diagram.](#)

[Figure 7.3 System model \[34\].](#)

[Figure 7.4 Network design of WSN in proposed system.](#)

[Figure 7.5 Network design with cluster head in the proposed system.](#)

[Figure 7.6 Results comparison of Reference paper \[5, 13, 14\].](#)

[Figure 7.7 Results comparison of various performance parameters.](#)

[Figure 7.8 Shows the residual energy of the system w.r.t. simulation time.](#)

[Figure 7.9 End-to-end delay vs. simulation time.](#)

[Figure 7.10 Shows the number of hops is less and requires less number of relay n...](#)

Chapter 8

[Figure 8.1 Block diagram of PV-based inverter fed drive.](#)

[Figure 8.2 Electrical model of Solar cell.](#)

[Figure 8.3 I-V and P-V characteristics of PV array.](#)

[Figure 8.4 MATLAB Simulink Model of Single-Phase H Bridge Inverter.](#)

[Figure 8.5 Simulation Output of Single-Phase H Bridge Inverter.](#)

[Figure 8.6 MATLAB Simulink Model of Diode Clamped Multi-Level Inverter.](#)

[Figure 8.7 Five Level Line Voltage Waveform.](#)

[Figure 8.8 Five Level Phase Voltage Waveform.](#)

[Figure 8.9 Five level voltage w.r.t. to DC terminal.](#)

[Figure 8.10 MATLAB Simulink Model of PV powered H Bridge Inverter fed Drive.](#)

[Figure 8.11 Output Waveforms of PV powered H Bridge Inverter fed Drive.](#)

[Figure 8.12 MATLAB Simulink Model of PV powered DCMLI fed Drive.](#)

[Figure 8.13 Output Waveforms of PV powered DCMLI fed Drive.](#)

[Figure 8.14 MATLAB Simulink Model of PV powered Cascaded H Bridge MLI-fed Drive.](#)

[Figure 8.15 Subsystem Block of PV powered Cascaded H Bridge MLI-fed Drive.](#)

[Figure 8.16 Phase voltage waveform.](#)

[Figure 8.17 Line voltage waveform.](#)

Chapter 9

[Figure 9.1 Existing energy storage system with universal controller.](#)

[Figure 9.2 Proposed energy storage system with universal controller.](#)

[Figure 9.3 Overall proposed converter circuit.](#)

[Figure 9.4 Single-stage rectification.](#)

[Figure 9.5 Single-stage inversion.](#)

[Figure 9.6 e-Chopper.](#)

[Figure 9.7 Mode-1 duty interval.](#)

[Figure 9.8 Mode-2 free-wheeling interval.](#)

[Figure 9.9 Double-stage rectification.](#)

[Figure 9.10 Single-stage rectification output/e-chopper input.](#)

[Figure 9.11 Double-stage inversion.](#)

[Figure 9.12 Charging mode.](#)

[Figure 9.13 Duty mode.](#)

[Figure 9.14 Inverter mode \(power flow from WECS to grid\).](#)

[Figure 9.15 E-chopper control.](#)

[Figure 9.16 3Ø inverter control system.](#)

Figure 9.17 Proposed CB-PWM approach representation by zero-sequence injection.

Figure 9.18 Experiment result VL.

Figure 9.19 Experiment result of line voltage when $V_L = 250V$.

Figure 9.20 Steady state waveform $V_L = 350V$.

Figure 9.21 Proposed system dynamic waveform.

Figure 9.22 Power loss comparion T-Traditional, P-Proposed.

Figure 9.23 THD and harmonic analysis.

Chapter 10

Figure 10.1 Three sections of energy segment.

Figure 10.2 Benefits of IOT in renewable energy sources.

Figure 10.3 Chart representing the parts of an IoT stage.

Figure 10.4 Different types of sensors for different applications.

Figure 10.5 Classic wireless sensor node design.

Figure 10.6 An integrated information connectivity in a smart city model.

Figure 10.7 Segment of domestic energy intake.

Figure 10.8 Claims of Internet of Things within incorporated intelligent vitalit...

Figure 10.9 Innovation in energy sector with block chain and IOT.

Figure 10.10 Virtual power plant with artificial intelligence and IOT.

[Figure 10.11 Green energy and Internet of Things as a crucial technology.](#)

Chapter 11

[Figure 11.1 Electricity generated through different renewable energy source in 2...](#)

[Figure 11.2 Sugar based bio-energy produced and transferred to the grid \[45\].](#)

Chapter 12

[Figure 12.1 Electrical energy production from various sources \(2018 figures\).](#)

[Figure 12.2 Parabolic trough arrangement.](#)

[Figure 12.3 Dish type collectors.](#)

[Figure 12.4 Tower type power system.](#)

[Figure 12.5 Water heating.](#)

[Figure 12.6 Building using passive heating.](#)

[Figure 12.7 Use of process heat for buildings.](#)

[Figure 12.8 Wind turbines.](#)

[Figure 12.9 Geothermal plant in Iceland.](#)

Chapter 13

[Figure 13.1 Block diagram of the proposed system.](#)

[Figure 13.2 DAS versus critical growth stages and optimum temperature \(°C\) requi...](#)

[Figure 13.3 Flow chart.](#)

[Figure 13.4 Plots between \(a\) Sensor output voltage and sensor analog voltage \(b...](#)

[Figure 13.5 Layout of the sprinkler system.](#)

[Figure 13.6 Testing system for lab and field.](#)

[Figure 13.7 Snapshot of \(a\) Gauges and charts on cloud showing real-time data. \(...](#)

Chapter 14

[Figure 14.1 Obaidat *et al.* Reference architecture for IoT \[16\].](#)

[Figure 14.2 Components of IoT \[10\].](#)

[Figure 14.3 Vongsingthong *et al.* hierarchy of user authentication method \[6\].](#)

[Figure 14.4 Mahadi *et al.* Demonstrate the varied machine learning approach \[5\].](#)

[Figure 14.5 Various gait operations in proposed method.](#)

[Figure 15.1 Block diagram.](#)

[Figure 15.2 NODEMCU ESP8266 Pinouts.](#)

[Figure 15.3 \(a\) SW-420 Vibration Sensor, \(b\) KE-25 Oxygen Sensor, \(c\) NDIR Carbo...](#)

[Figure 15.4 System structure.](#)

[Figure 15.5 Working prototype of the problem with blinking LED.](#)

[Figure 15.6 LED blinking with the second type sensor.](#)

[Figure 15.7 \(a-d\) Measurement of the Temperature and Humidity in four different ...](#)

[Figure 15.8 Module output associated with the data for temperature and humidity ...](#)

Chapter 16

[Figure 16.1 Publication data for IoT and its challenges.](#)

[Figure 16.2 IoT Architecture \[1\].](#)

[Figure 16.3 Application areas of Internet of Things \(IoT\) \[3\].](#)

[Figure 16.4 Block diagram showing an IoT system.](#)

Chapter 17

[Figure 17.1 Basic Structure of FinFET.](#)

[Figure 17.2 \(a\) Ultra-thin body \(b\) Dual gate.](#)

[Figure 17.3 \(a\) Planar double-gate FET \(b\) 90° rotation DG-MOSFET \(c\) 90° rotati...](#)

[Figure 17.4 \(a\) FinFET \(b\) Q-gate MOSFET \(c\) GAA MOSFET.](#)

[Figure 17.5 \(a\) IG-FinFET \(b\) Shorted Gates.](#)

[Figure 17.6 Fin width variability.](#)

[Figure 17.7 14nm FinFET Structure.](#)

[Figure 17.8 \(a\) 7T SRAM cell with FinFET \(b\) 1T DRAM cell with FinFET.](#)

[Figure 17.9 Side view of FinFET as biosensing cavity region.](#)

Chapter 18

[Figure 18.1 The role of multi-level inverters in a typical Microgrid.](#)

[Figure 18.2 Suggested 19-level inverter topology.](#)

[Figure 18.3 Operational modes for producing \$\pm 9V_{dc}\$ output voltage steps.](#)

[Figure 18.4 Operational modes for producing \$\pm 8V_{dc}\$ output voltage steps.](#)

Figure 18.5 Operational modes for producing $\pm 7V_{dc}$ output voltage steps.

Figure 18.6 Operational modes for producing $\pm 6V_{dc}$ output voltage steps.

Figure 18.7 Operational modes for producing $\pm 5V_{dc}$ output voltage steps.

Figure 18.8 Operational modes for producing $\pm 4V_{dc}$ output voltage steps.

Figure 18.9 Operational modes for producing $\pm 3V_{dc}$ output voltage steps.

Figure 18.10 Operational modes for producing $\pm 2V_{dc}$ output voltage steps.

Figure 18.11 Operational modes for producing $\pm V_{dc}$ output voltage steps.

Figure 18.12 Operational modes for producing zero output voltage step.

Figure 18.13 Cascaded configuration of suggested structure.

Figure 18.14 Fundamental frequency method.

Figure 18.15 Gate pulses for switches of suggested structure.

Figure 18.16 Output voltage of suggested topology.

Figure 18.17 Number of sources per number of levels.

Figure 18.18 Number of capacitors per number of levels.

Figure 18.19 Number of semiconductors per number of levels.

[Figure 18.20 Per-unit total voltage stress per number of levels.](#)

[Figure 18.21 Cost function per number of levels.](#)

[Figure 18.22 Output voltage and current waveforms.](#)

[Figure 18.23 Voltage waveform of C₁-C₄ capacitors.](#)

[Figure 18.24 FFT analysis of suggested topology.](#)

[Figure 18.25 Voltage stress on switches of suggested topology.](#)

List of Tables

Chapter 1

[Table 1.1 Comparison of existing MOSFET structures.](#)

Chapter 2

[Table 2.1 Sutra in Vedic mathematics \[2-5\].](#)

[Table 2.2 FPGA utilization summary report.](#)

[Table 2.3 Cell area of 8x8 vedic multiplier.](#)

[Table 2.4 Power constraints of 8x8 vedic multiplier.](#)

[Table 2.5 Time constraint of 8x8 vedic multiplier.](#)

[Table 2.6 Cell area of 16x16 vedic multiplier.](#)

[Table 2.7 Power constraints of 16x16 vedic multiplier.](#)

[Table 2.8 Time constraint of 16x16 vedic multiplier.](#)

[Table 2.9 Comparison of multiplier architecture.](#)

Chapter 3

Table 3.1 Tristate pattern.

Chapter 6

Table 6.1 Details of Case Studied Pump.

Table 6.2 Major differences between VCR and VAR.

Table 6.3 Type of lamps.

Table 6.4 BEE star ratings for LED lamps.

Table 6.5 LED Luminaire Efficiency Labels of EU (EU 2019/2015) w.e.f 1st Septemb...

Table 6.6 Star ratings.

Table 6.7 Reference outdoor temperature in distribution.

Table 6.8 EU energy efficiency ratings.

Table 6.9 Induction and BLDC motor fans.

Table 6.10 Star Rating of 1200 mm Size Ceiling Fan, 2010.

Table 6.11 Underrated operation of a 200 HP, 4 pole motor.

Table 6.12 Energy-efficiency ratings of BEE.

Table 6.13 Minimum energy performance standards of a 250 KW motor.

Table 6.14 Energy-efficiency ratings of IEC.

Table 6.15 Transformer population progression.

Table 6.16 IEC recommendation (in %).

Chapter 7

Table 7.1 Values (End-to-end Delay) compared of Reference papers [5, 13, 14].

[Table 7.2 Values \(Residual energy\) compared of Reference papers \[5, 13, 14\].](#)

[Table 7.3 Table showing the primary and the proposed method comparison of simula...](#)

[Table 7.4 Comparison Table of a primary and a proposed method between simulation...](#)

[Table 7.5 Comparison Table of basic and proposed system between simulation time ...](#)

Chapter 8

[Table 8.1 Performance comparison of H-bridge inverter and MLI fed drives based o...](#)

[Table 8.2 Performance comparison of H-bridge inverter and MLI fed drives based o...](#)

Chapter 9

[Table 9.1 R phase power transfer switching.](#)

Chapter 10

[Table 10.1 Evaluation chart of different wireless technologies \[1, 62, 93-98\].](#)

[Table 10.2 Claims - Internet of Things for vitality region \(1\): rule, marketplac...](#)

[Table 10.3 Uses -Internet of Things within vitality area.](#)

[Table 10.4 Experiments as well as present clarifications by use of Internet of T...](#)

Chapter 12

[Table 12.1 The primary energy supply & consumption.](#)

Chapter 13

Table 13.1 Water requirement of India for different sectors accessed by NCIWRD, ...

Table 13.2 Per capita annual water availability of India [1].

Table 13.3 Calibrated data Of Yl-69.

Table 13.4 FC and WP at different depths of soil.

Table 13.5 Design details and irrigation data.

Chapter 14

Table 14.1 Internet of Things' characteristics.

Table 14.2 Various security solutions at layers in IoT architecture.

Table 14.3 Brief outline of possession-based method.

Table 14.4 Brief outline of physical biometric-based method.

Table 14.5 Brief outline of behavioral biometric-based method.

Chapter 17

Table 17.1 Current I_{ON} and I_{OFF} for different back-gate voltages.

Table 17.2 Comparison of MOSFET and FinFET.

Chapter 18

Table 18.1 Switching states, output voltage and capacitors mode of suggested top...

Table 18.2 Voltage stresses on switches.

Table 18.3 Key parameters of cascaded configuration of suggested topology.

Table 18.4 Look-up table for generating output voltage levels.

Table 18.5 Relationships for calculating output t_1 - t_{16} .

Table 18.6 Component counts of suggested structure and presented structures in [...

Table 18.7 Simulation parameters.

Scrivener Publishing

100 Cummings Center, Suite 541J
Beverly, MA 01915-6106

Publishers at Scrivener

Martin Scrivener (martin@scrivenerpublishing.com)
Phillip Carmical (pcarmical@scrivenerpublishing.com)

Design and Development of Efficient Energy Systems

Edited by

Suman Lata Tripathi

Dushyant Kumar Singh

Sanjeevikumar Padmanaban

and

P. Raja



WILEY

This edition first published 2021 by John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA and Scrivener Publishing LLC, 100 Cummings Center, Suite 541J, Beverly, MA 01915, USA

© 2021 Scrivener Publishing LLC

For more information about Scrivener publications please visit
www.scrivenerpublishing.com.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, except as permitted by law. Advice on how to obtain permission to reuse material from this title is available at <http://www.wiley.com/go/permissions>.

Wiley Global Headquarters

111 River Street, Hoboken, NJ 07030, USA

For details of our global editorial offices, customer services, and more information about Wiley products visit us at www.wiley.com.

Limit of Liability/Disclaimer of Warranty

While the publisher and authors have used their best efforts in preparing this work, they make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives, written sales materials, or promotional statements for this work. The fact that an organization, website, or product is referred to in this work as a citation and/or potential source of further information does not mean that the publisher and authors endorse the information or services the organization, website, or product may provide or recommendations it may make. This work is sold with the understanding that the publisher is not engaged in rendering professional services. The advice and strategies contained herein may not be suitable for your situation. You should consult with a specialist where appropriate. Neither the publisher nor authors shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages. Further, readers should be aware that websites listed in this work may have changed or disappeared between when this work was written and when it is read.

Library of Congress Cataloging-in-Publication Data

ISBN 9781119761631

Cover images: Electrical Systems - Suman Kumar Singh | Dreamstime.com
Solar Panels - Adisak Rungjaruchai | Dreamstime.com

Cover design by Kris Hackerott

Set in size of 11pt and Minion Pro by Manila Typesetting Company, Makati, Philippines

Printed in the USA

10 9 8 7 6 5 4 3 2 1

Preface

The objective of this edition is to provide a broad view of the fundamental concepts of green energy technology and applications in a concise way for fast and easy understanding. This book provides information regarding almost all the aspects to make it highly beneficial for all students, researchers and teachers of this field.

Fundamental principles of green energy technology with the latest developments are discussed in a clear and detailed manner with explanatory diagrams wherever necessary. The book focuses on the basic concepts of Internet of Things (IoT) in power conversion, IoT in renewable energy, and adoption of machine learning, low-power device and circuit design including the latest research available depending upon the technological changes based upon their application.

Chapter Organization

Chapter 1 deals with prefabrication low-power device design and analysis on Visual TCAD device simulator with graphical and programming interfaces. Also, the chapter discusses the design of device-based low-power memory and biomedical applications.

Chapter 2 mainly describes Vedic multiplication based on the compressor block that is focused on the reduction of interconnect wire. The multiplier is implemented using Verilog HDL with cadence NC SIM and the constrain areas, power and delay optimize using underlying block.

Chapter 3 deals with gas leakage detection from drainage to offer safety for sanitary workers from gases such as Carbon monoxide (CO), Hydrogen sulphide (H₂S), and

Methane (CH4), which are some of the hazardous gases present in underground drainage systems.

Chapter 4 presents a smart healthcare system development with machine learning, which is energy efficient, with reduced network latency and minimum bandwidth.

Chapter 5 This chapter presents some of the solutions in literature for implementing security. The chapter also covers different types of attacks such as goal-oriented attack, performer-oriented attack and layer-oriented attack.

Chapter 6 addresses the energy-saving component and the application of digital technology and Internet of Things (IoT) in large-scale process industries.

Chapter 7 discuss the method deployed relay node in such a way that the network will behave like a sensor network with the help of K-Means clustering approach.

Chapter 8 analyzes an MLI fed Induction Motor Drive by considering Solar Energy as a source. The effects of employing various types of MLI for a PV source-based drive, and methods of deriving maximum drive efficiency are elaborated in this chapter with sufficient simulation results.

Chapter 9 describes energy storage systems using a universal controller that can work for a wide range of voltage to both DC and AC loads with high power rating and low power loss.

Chapter 10 explores energy arrangement producers, energy financial analysts, and directors with a review of the job of IoT in enhancement of energy frameworks.

Chapter 11 focuses on integration of photovoltaic cell, wind energy and other forms of renewable energy. It also

covers microgrid systems with high reliability, less transmission losses and improved power system efficiency.

Chapter 12 describes state-of-the-art renewable energy systems and highlights the global efforts being made to increase their efficiency.

Chapter 13 is dedicated to Internet of Things (IoT) technologies with best solutions, ease of the task of monitoring and analysis that opens up a wide range of prospects for making better future decisions.

Chapter 14 examines new security challenges in the Internet of Things (IoT) using machine learning algorithm and the system of interrelated computing devices for its quick development and distribution that are essential for internet and smart device users.

Chapter 15 presents a working and solution process, an illustrative fuzzily defined mathematical framework for optimizing food quality. Here, the emphasis is not only on ensuring fruit safety but also avoiding foodborne diseases.

Chapter 16 is an overview of the various requirements for Internet of Things (IoT) systems and architectures, highlighting different research challenges and security issues connected with IoT.

Chapter 17 presents a state-of-the-art of FinFET technology with low power consumption and their application in a low-power VLSI circuit.

Chapter 18 proposes a single-source high step-up switched-capacitor-based 19-level inverter topology with enhanced power quality that can be extended by addition of switched-capacitor units. The extended topology can produce larger gain and voltage steps.